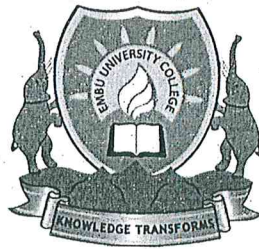


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EMBU UNIVERSITY COLLEGE
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

SECOND SEMESTER EXAMINATIONS 2013/2014

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF SCIENCE

SPH 201: MECHANICS II

DATE: MARCH 31, 2014

TIME: 2.00 - 4.00PM

INSTRUCTIONS:

ANSWER QUESTION ONE (30 MARKS) AND ANY OTHER TWO QUESTIONS (20 MARKS EACH)

QUESTION ONE

- a) State the three Kepler's laws of planetary motion. (3 marks)

- b) What is a geostationary satellite for earth and what are they used for? (3 marks)

- c) i) Differentiate between the three states of damping. (3 marks)

- ii) Sketch their displacement time graphs. (3 marks)

- d) A student asserts that the gravitational field and gravitational potential are one and the same. Explain your answer. (3 marks)

- e) What is a Fourier series and how is it important in the analysis of periodic motion? (4 marks)
- f) Explain briefly what a forced oscillator is and give a practical example. (3 marks)
- g) What is resonance and what is its impact on a forced oscillator? (4 marks)
- h) Differentiate between Galilean and Lorentz transformations. (4 marks)

QUESTION TWO

- a) Io, a satellite of Jupiter, has an orbital period of 1.77 days and an orbital radius of 4.22×10^5 km. From these data, determine the mass of Jupiter. (5 marks)
- b) A satellite has a mass of 100 kg and is located at 2.00×10^6 m above the surface of Earth.
 (i) What is the potential energy associated with the satellite at this location? (ii) What is the magnitude of the gravitational force on the satellite? (9 marks)
- c) A 600 kg satellite is in a circular orbit about Earth at a height above Earth equal to Earth's mean radius. Find (i) the satellite's orbital speed, (ii) the period of its revolution, (6 marks)

QUESTION THREE

- a) Starting from the equation $x = A \cos(2\pi f t)$ where x is the displacement of SHO from the equilibrium position, A , is the amplitude and, f , the frequency, derive an expression of its velocity and acceleration. Hence draw sketch graphs of:-
- (i) Displacement versus time,
 (ii) Velocity versus time and
 (iii) Acceleration versus time for one oscillation of the SHO.
- (10 marks)

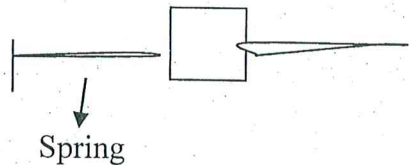
- b) Starting with a pendulum of length L , displace a distance s from equilibrium and a small angle θ , show that its oscillation resembles that of a simple harmonic oscillator. Hence derive an expression of its period. (10 marks)

QUESTION FOUR

- a) A 0.4Kg mass that is attached to an ideal spring executes SHM of 0.2 m amplitude. The maximum speed of the mass during this motion is 5 m/s. What is the frequency of the SHM, and what is the spring constant of the spring? (8 marks)
- b) Two clocks, A and B have identical pendulums. The pendulum of A has an amplitude of 5° ; that of B an amplitude of 15° . Which of the two clocks will run slow, and how much time will the slow clock lose during one day as measured by the faster clock? (12 marks)

QUESTION FIVE

- a) A mass of 0.8 kg is supported on a frictionless table and is attached to two identical springs as shown below. If the mass is pulled along the line joining the fixed ends of the two springs and then release, it oscillates with a frequency of 12 Hz. Find the spring constants of the springs. (10 marks)



- b) Obtain the Fourier series to represent $f(x) = \frac{1}{4}(\pi - x)^2$ in the interval $0 \leq x \leq 2\pi$ (10 marks)

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